PART TWO OUTLINE

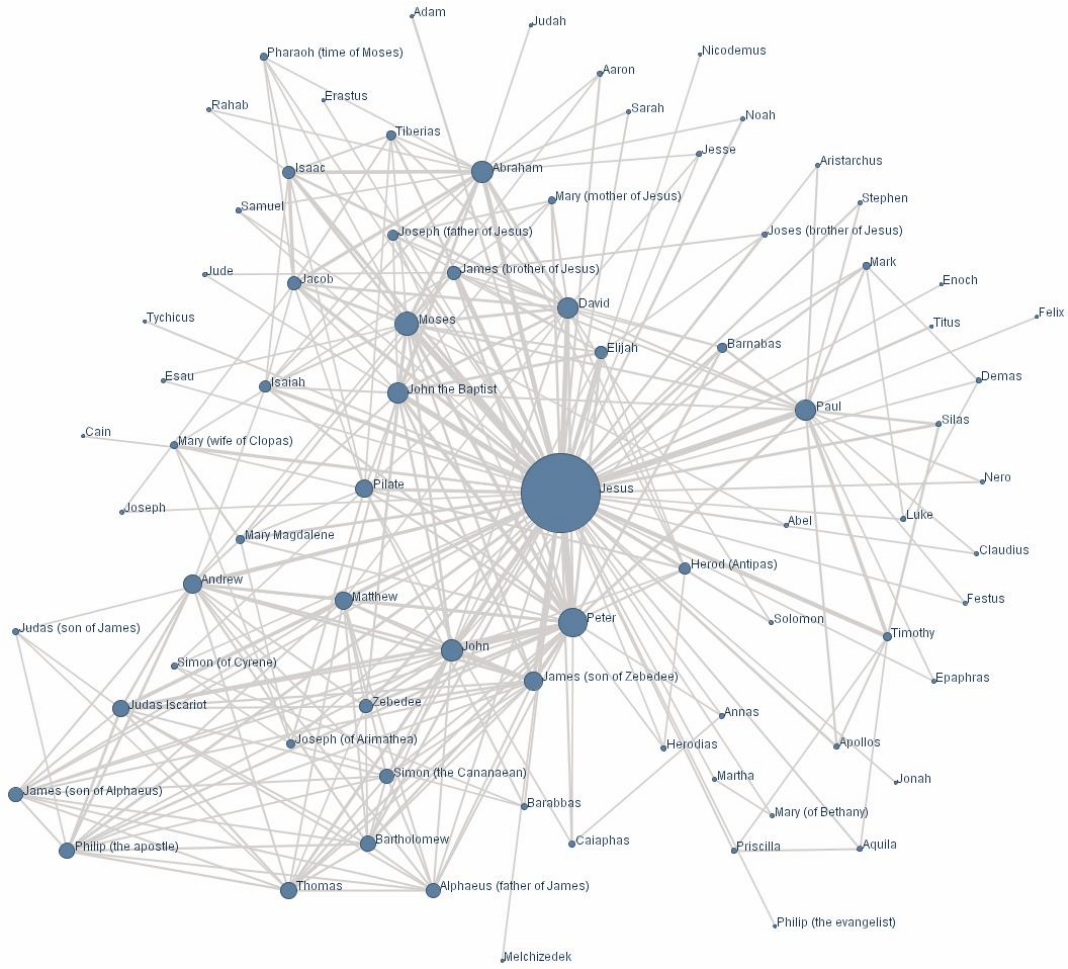
- R&D CASES RELATED TO MOBILE SERVICES:
  - Social Networks – Data management in human networks
  - Connected Objects or the Internet of Things
  - Mobile Search and Advertising
  - Open Innovation Platforms and Testbeds

Social Networks - Outline

- Introduction
- Motivation
- Background: Datom and Haggle
- Bedouin: The integration of two systems
- Caravan: A P2P file sharing application for human networks
- Future work and conclusions

Introduction

- High-level, soft view of social networks



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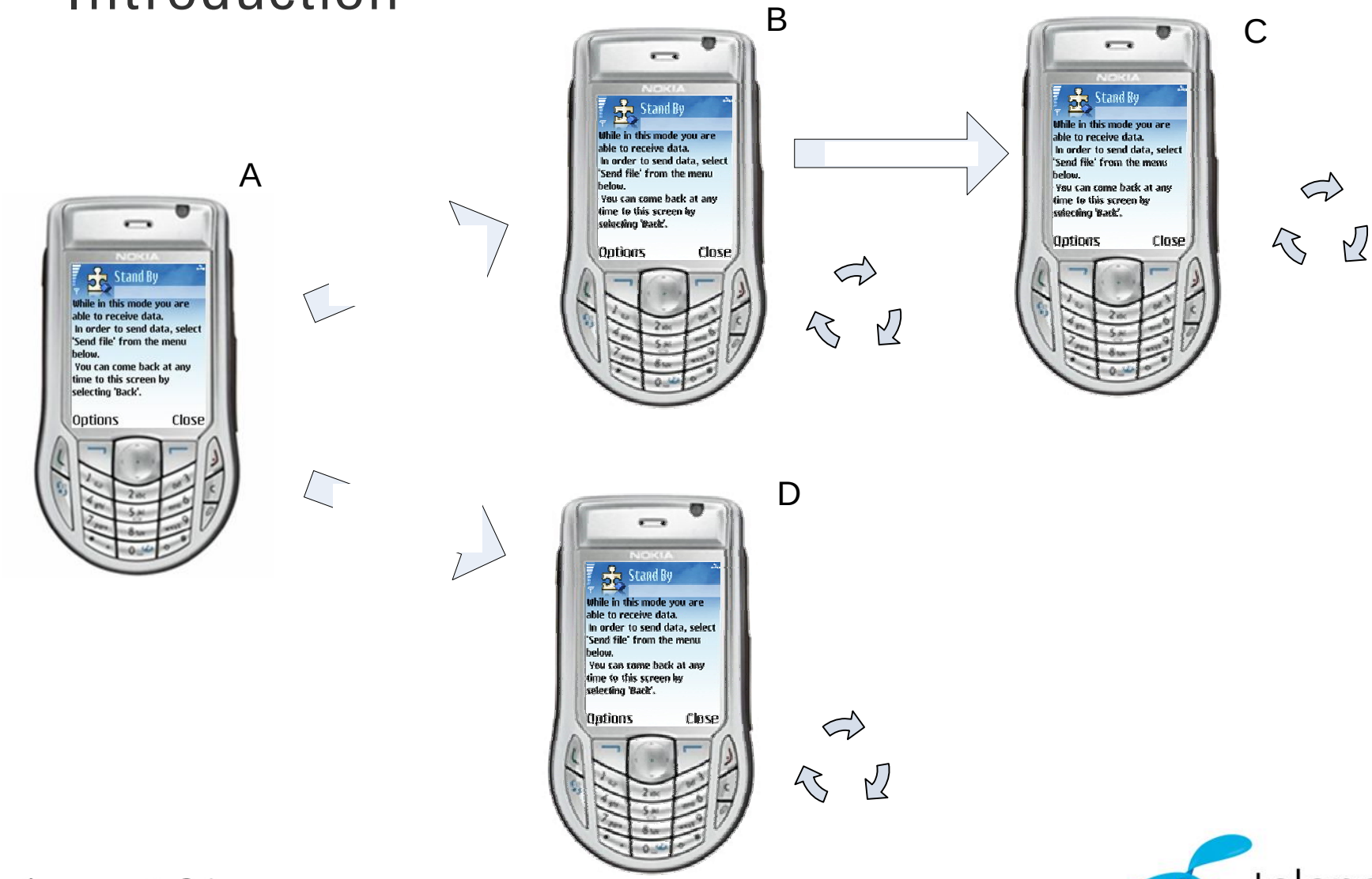
Introduction

- What we mean by “human networks”
  - Using personal devices to store/transport/forward data in the network
  - Exploit human mobility and opportunistic connectivity
  - Enable infrastructure-independent networking mechanisms

- The data transmission challenge in Human Networks
  - Long and variable communication delays
  - Frequent communication disruptions
  - Arbitrary periods of link disconnection

Introduction



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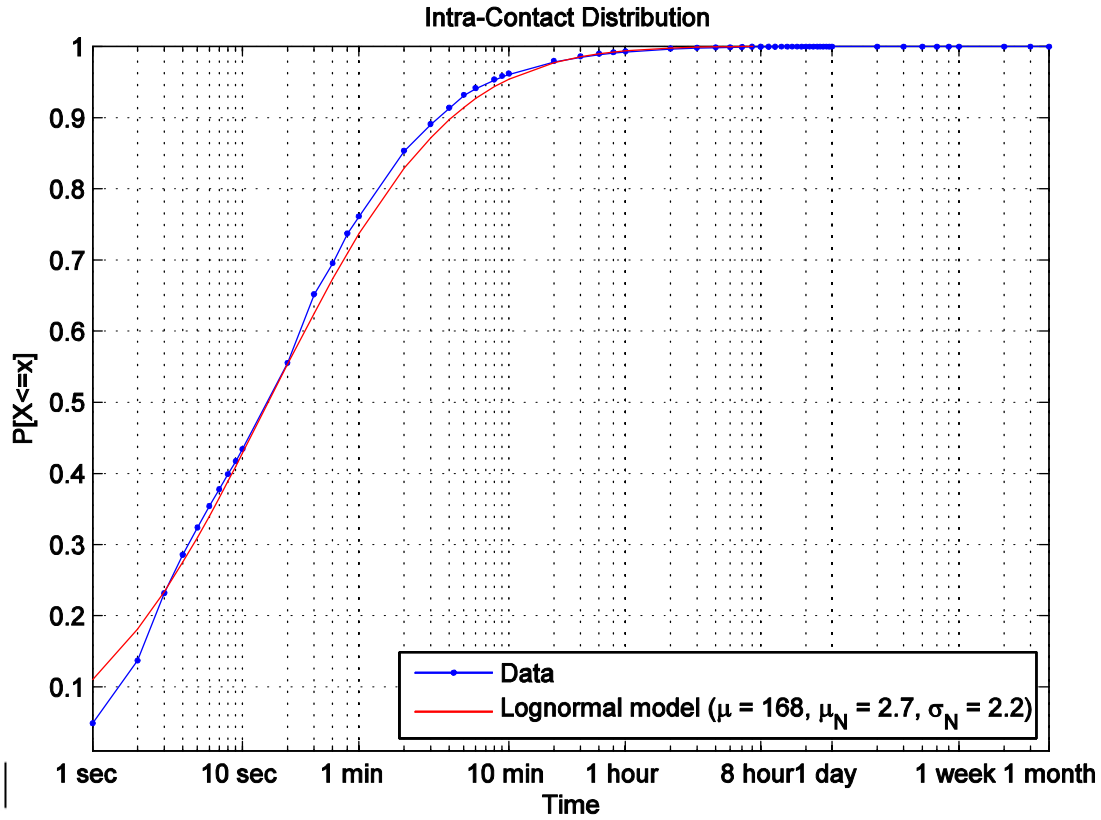
Motivation

- Short contact times are an issue in reality:
  - Contact times between WiFi users over the course of 3 years
  - Roughly 55% of all intra-contact times lasted less than 20 sec
  - Other wireless technologies may exhibit shorter intra-contact time



Source: Crawdad project dataset [Kotz et al, 05]

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Motivation

- How to optimise the amount meaningful data exchanges in the event of common disruptions and short contact times?
  - Short contact times do not allow for complete file or bundle transmissions
- In the networking context:
  - Data encapsulation and fragmentation ignores data semantics
  - Data as a flat stream of bits does not allow cooperation between network and applications
  - Not easy to prioritise portions of a data stream in an application-meaningful way
- In the data storage context:
  - The File API: a generic way to manipulate application data with a poor understanding of application's data semantics
  - Access to a file as a whole (all-or-nothing), partial data has to be discarded, or stored to be reused later
  - Application data semantics are lost within the data stream

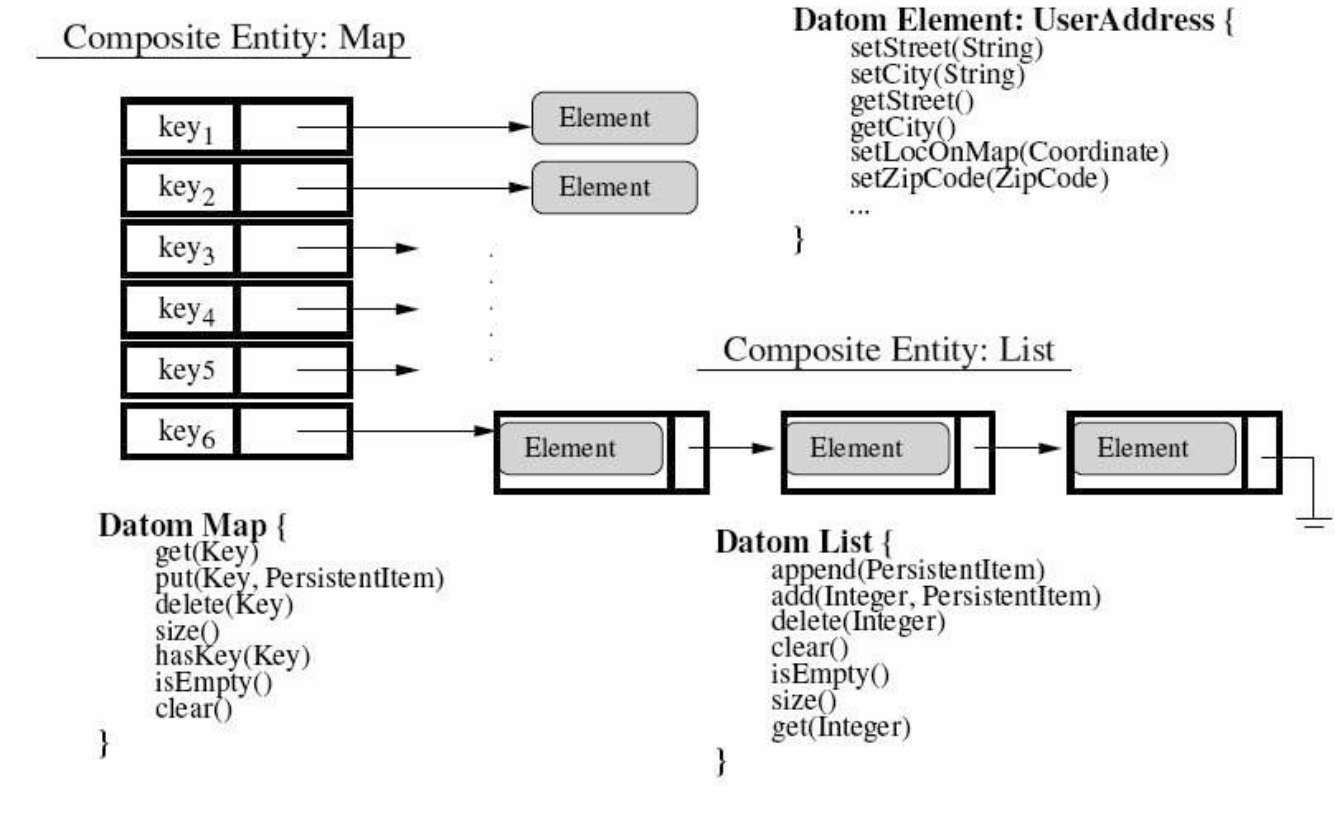
Motivation

- Data transmission in human networks (DTNs) can be improved with the synergy of the network and applications
  - With the appropriate mediator cooperation can be enabled
  - *Mediator* = augmented data abstractions in the persistent data model
- Fine-grained data transmission prioritisation according to the application and user preferences
- Meaningful data units transmitted across temporal paths
- The integration of a semantically rich storage model to a network framework capable of exploiting this augmented expressive power
  - **Datom**: An abstract view of data [Policroniades 05]
  - **EU-project Haggle**: A clean slate networking model [Scott et al, 06]

Background - On the data storage side

- The Datom storage layer: An augmented level of data abstraction made explicit to the network
  - Composite Entities (CE): map, list, queue, stack, and matrix ADTs
    - Persistence-capable data structures
    - Equivalent to nodes in the graph of persistence of the Datom data model
    - Common ADTs used by applications to manage persistent data
  - Elements (E)
    - Fundamental unit of storage
    - The abstractions that applications use to store units of data
    - Application-specific programming abstractions with rich semantics and defined access routines
- Implemented as a light-weight storage layer
  - Incremental data loading based on navigation: skeleton with surrogates then fetch concrete elements
  - Selective reachability: only dirty data is pushed to persistent storage

Background - On the data storage side



- Hints for the network layer: Organise, access, and transmit application data reflecting the access patterns of applications in a systematic way

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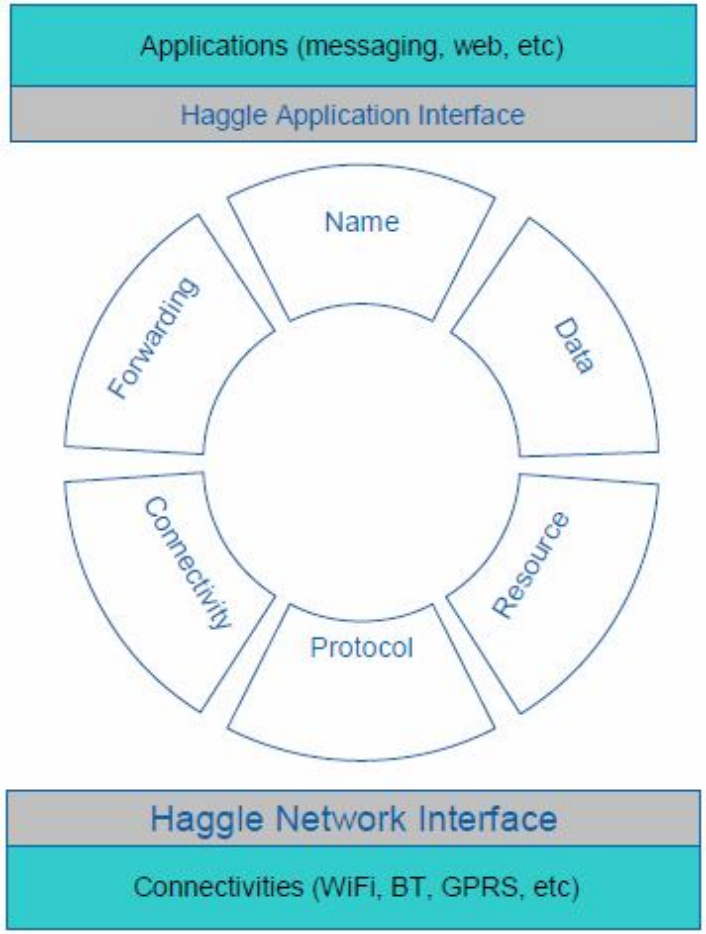
Background - On the networking side

- EU project - Haggle: Clean-slate networking framework
  - Isolate apps from networking decisions
  - Data persistence, multiple networking protocols, name graphs with late bindings, centralised resource management
  - Layerless architecture based on managers
  - Inter layer communication
- General networking architecture
- Allows DTN functionality
- Extensible architecture
- Open source



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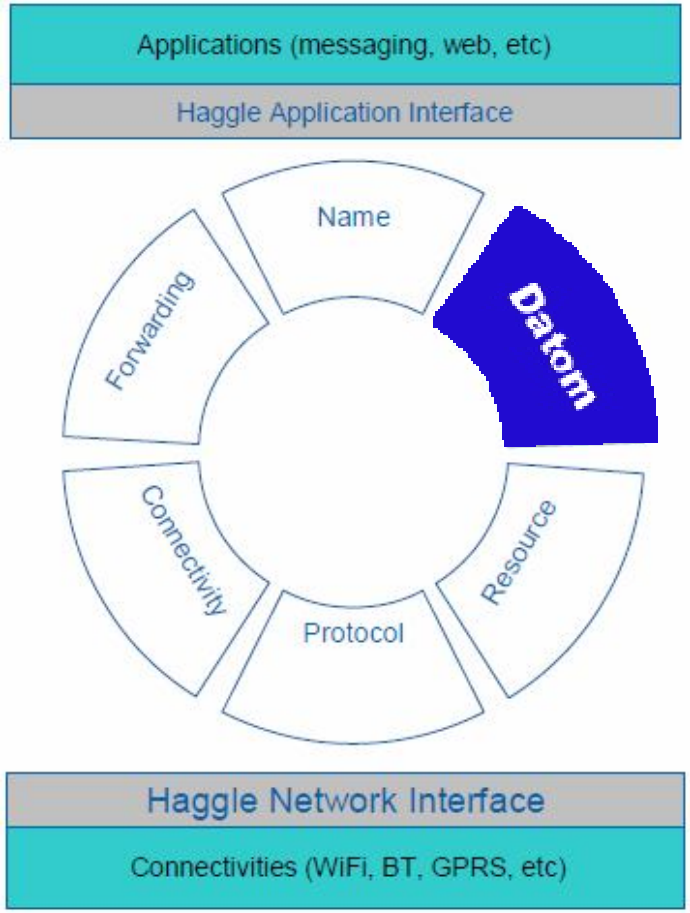
Bedouin: The fusion of the two systems



- Improves data management in human networks by:
  - Explicit persistent data layout: structured data and metadata
  - Explicit data access patterns and semantics
  - Hint data transmission order, priority, and granularity
  - Maximise the utility of data transmissions in human networks
  - Enables cooperation between network and applications
- A J2ME-CLDC porting for resource constrained devices

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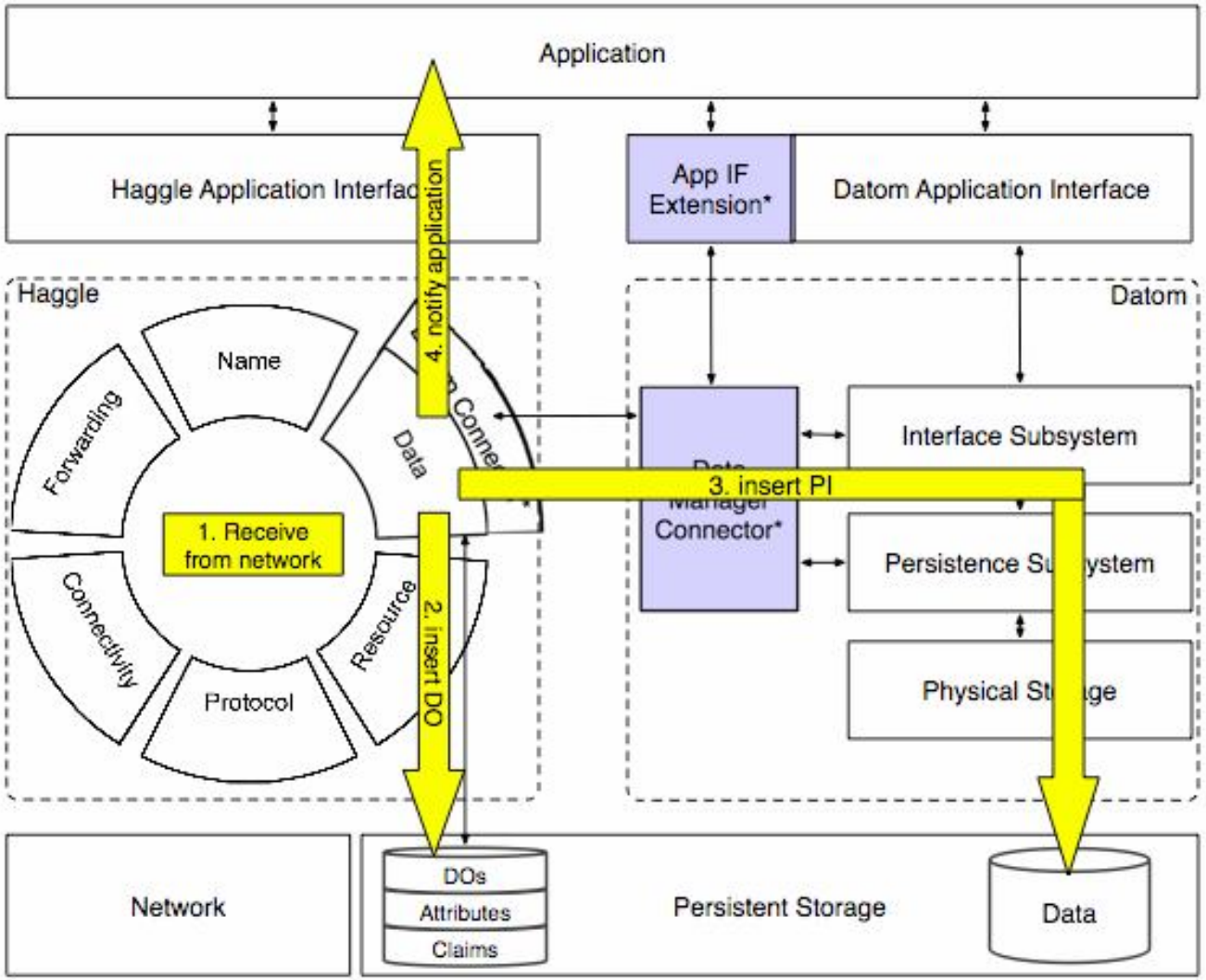
Bedouin: Implementation



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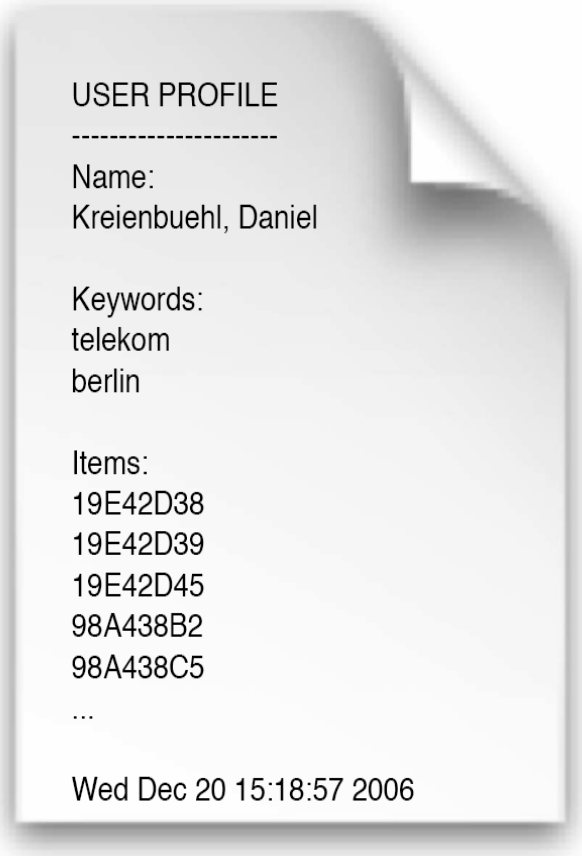
Caravan: A Bedouin-based P2P file sharing application

- P2P file-sharing in human networks requires
  - Use of local connectivity
  - Exchange of short, meaningful data portions
- Design
  - Advertisement of interests based on Caravan Interest Profile (CIP)
    - Event-based dissemination
    - Time-based dissemination
  - Graph information message
  - Reply with individual PIs of Datom graph
- Running demo an a set of Nokia 6630 [HOTMOBILE 2006]



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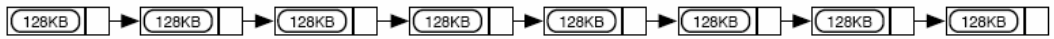
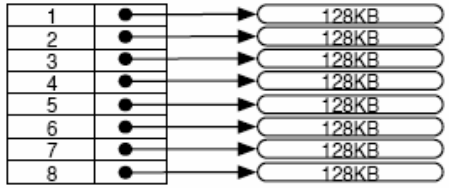
Evaluation

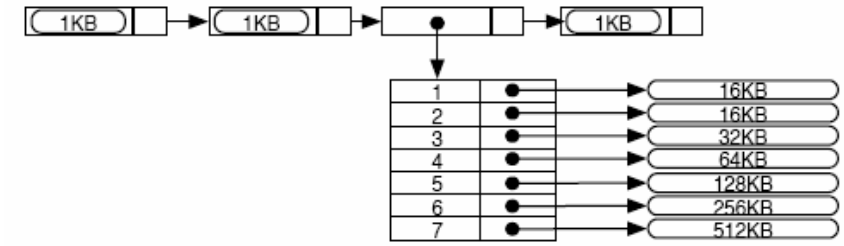
- Compare transfer time of datomised files to whole-file transmission over a Bluetooth connection
- 3 data sets, each of 1MB size in total
  - List with 8 elements of 128KB



  - Map with 8 entries of 128KB



  - Mixed graph to simulate PNG file – structure in critical and ancillary



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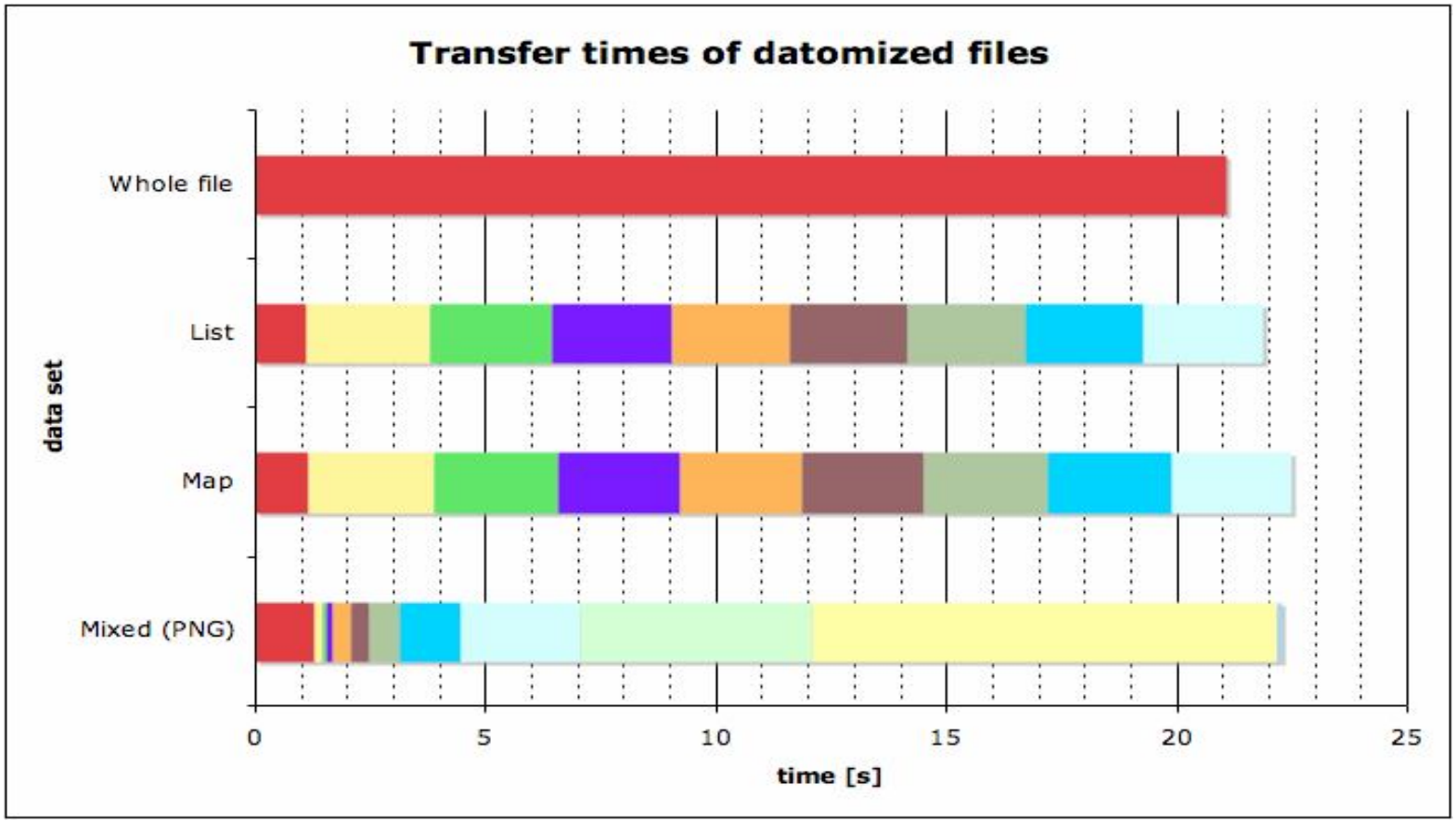
Evaluation



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Conclusions and Future Work

- Communications constraints in DTNs motivates the need for new data management
- Bedouin: Integration of Datom and Haggle
- To practically assess the benefits we implemented Caravan
- During short contact times Caravan is able to perform incremental data loading strategies and exchange meaningful portions of data

- Run tests in a realistic setting: Bedouin and Caravan in a large number of mobile phones in an office environment

PART TWO OUTLINE

- R&D cases related to mobile services:
  - Social Networks – Data management in human networks
  -  Connected Objects or the Internet of Things
  - Mobile Search and Advertising
  - Open Innovation Platforms and Testbeds

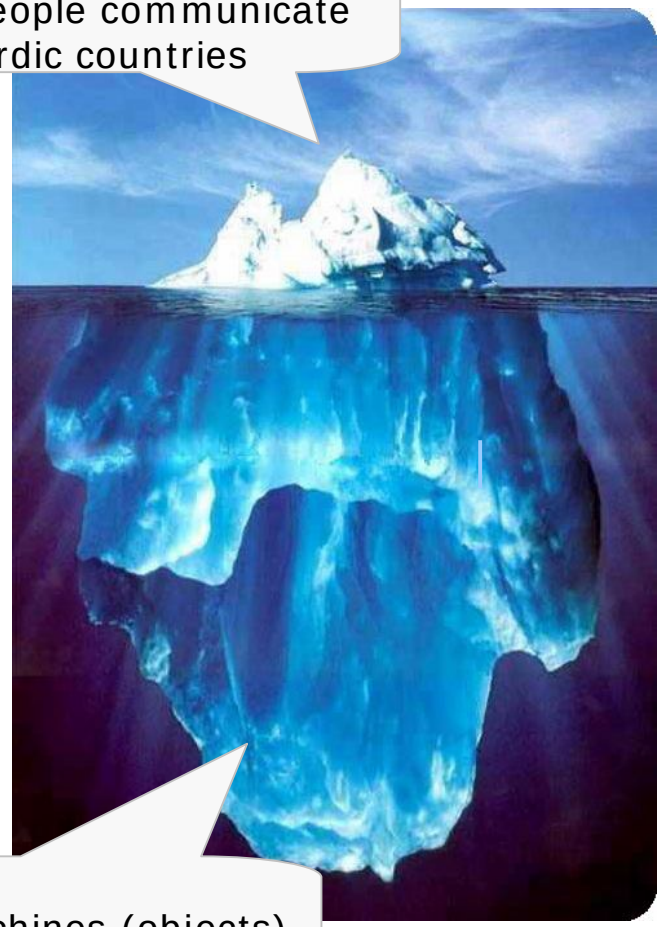
Connected objects - Outline

- Introduction
- Vision and strategy
- The Telcos role in the provision of CO services
- Practical examples
- Conclusions

“Things that think” – ambient inteligence - ubiquitous computing - connected objects

- So far mobile phones have first and foremost been used for communication between people

- Now machines (objects) can communicate – always on connectivity - mobility



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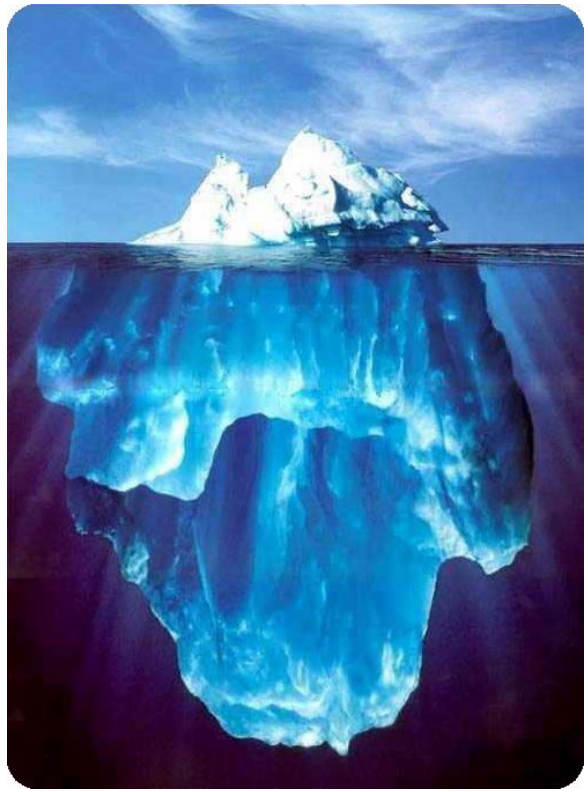
Source: Telenor Research & Innovation

Important drivers are ensuring “Things That Communicate” – Connected Objects – will be everywhere

- **Technology evolution is leading to reduced costs, miniaturisation and embedded processing**
- **Regulatory requirements are forcing technology based solutions**
- **Business efficiency through real time information about objects**
- **New business models based on embedded connectivity**
- **Connected home – remotely controlled, energy efficient, and secure**

A very large number of objects with networking capabilities and computational power are expected



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Connected Objects – or the Internet of Things - is expected to be a significant new market and encompass a large variety of services

Location of equipment and tracking of deliveries at construction sites

Location and status of content of train containers internationally

Monitor homes to warn about intruders, fire, floods, etc

Elderly living independently at home longer monitored remotely by health care professionals and "intelligent" appliances

Reduce CO2 with optimised use of transport fleet

Locate objects frequently lost (teddy bears, keys, glasses…)

Optimised energy use with intelligent appliances to better match demand with supply

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E.g. Enable the possibility of knowing exactly which animal a steak came from, where it roamed, and what kind of diseases it had before it was slaughtered

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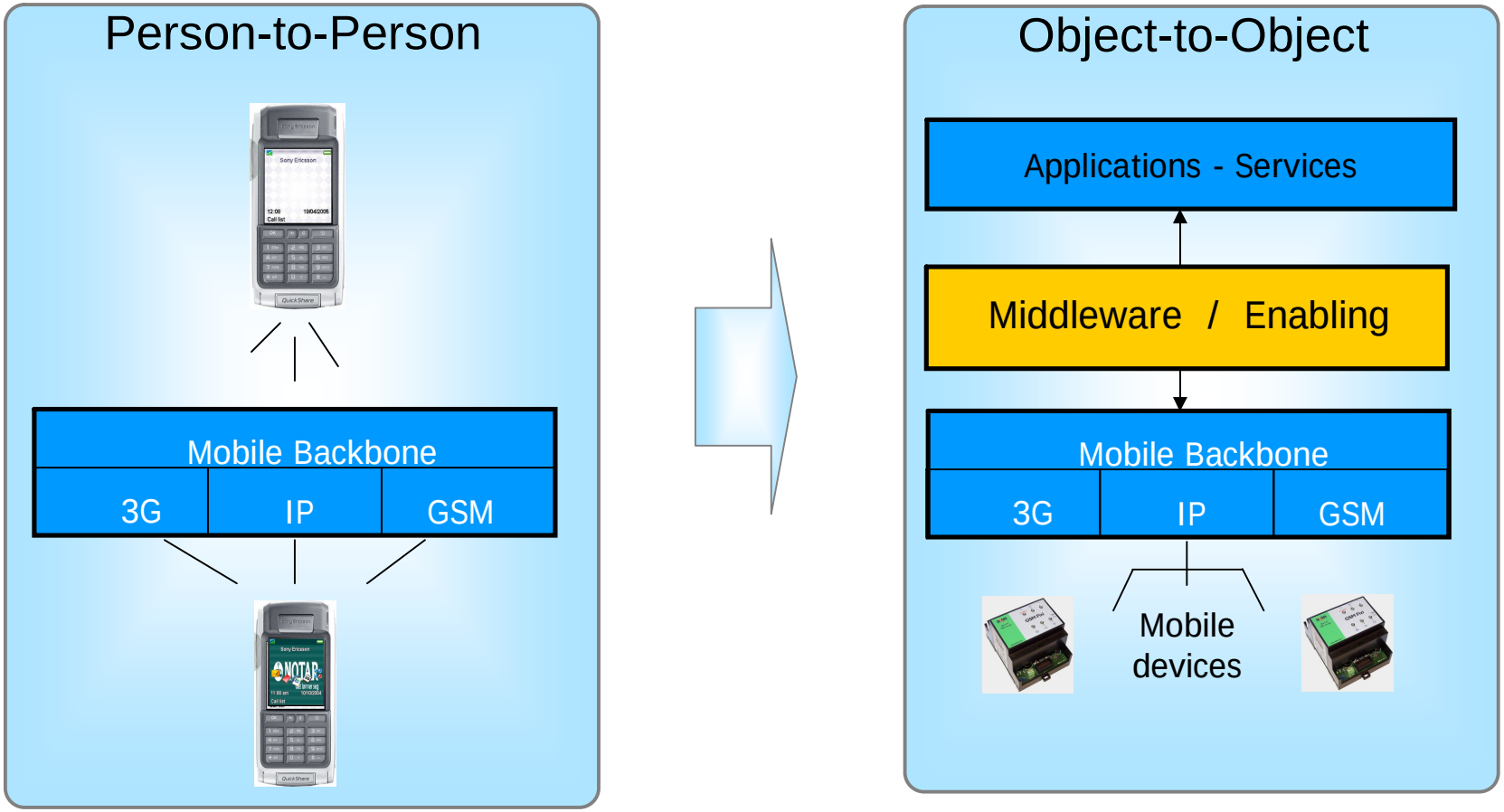
There are important differences between person-to-person communication and object-to-objects



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The Telcos vision

To be a driving force to develop a global market and take a major position in Connected Objects

This means:

- We will have to offer services beyond connectivity
- We will have to practice open innovation together with partners

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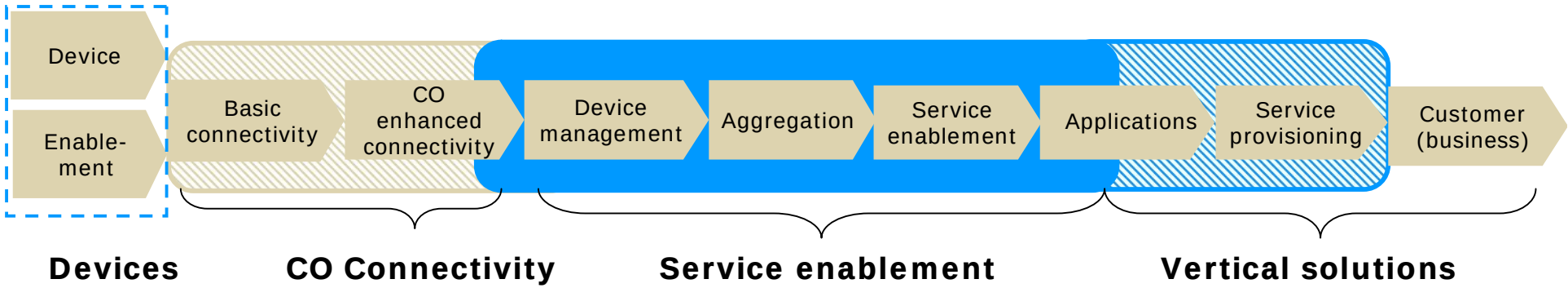
Telcos should leverage their capabilities and assets to take a significant position as a service enabler in a future market of CO



Our basic position in the market will be as a **CO connectivity provider and service enabler**, but we also plan to offer fully managed applications for selected verticals

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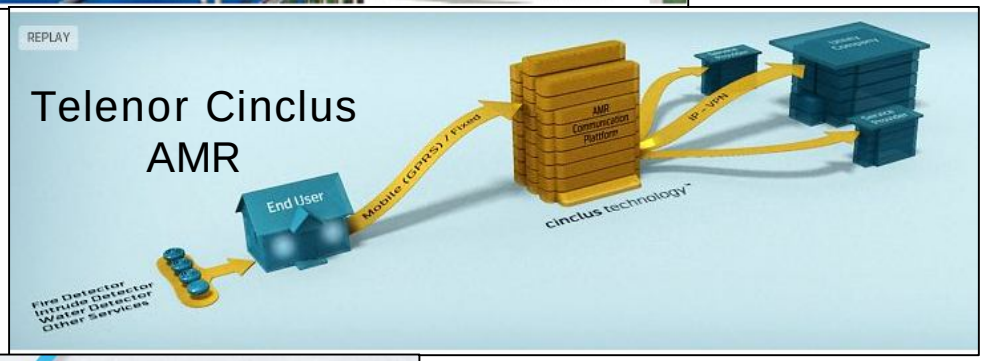
Telenor is actively participating in the Connected Objects market today



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Industry applications are developed locally and in cooperation with partners

EXAMPLES FROM NORWAY AND SWEDEN

Ongoing initiative		Description
IRIS		Asset management based mainly on RFID; main focus on facilities management
SeaCage		Monitoring of sea farm installations; currently developing a pilot in cooperation with industry partner
Wireless Tracking		Management of containers on international railway links; currently developing a commercial pilot with industry partner
Telespor		Location and tracking of sheep; limited commercial offer as a JV with industry partner
Telenor Cinclus		Managed automatic metering reading service on behalf of electricity providers; full service provider including meters and installation; commercial service

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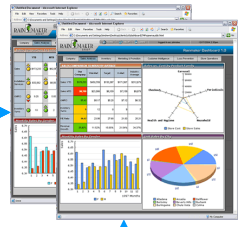
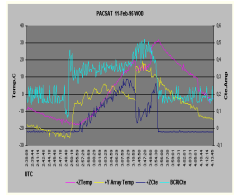
Fishermen

Drivers

Factory

Different users get access to different types of information.





Telenor Iris Portal
Provides Users with relevant information and historical data for analysis

Alerts and Information is sent to the relevant actors when required.
(e-mail or SMS)

Temperature Reader

Fixed RFID Readers

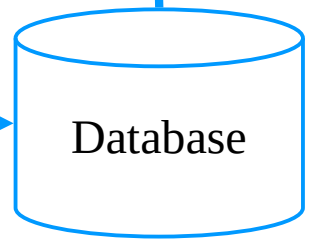
Fixed RFID Port

ADSL/GPRS/SMS Communication

Telenor Iris gathers salmon information (Registration, Transport Buy, Food, etc.)

Real Time salmon information is processed to generate alerts and business events

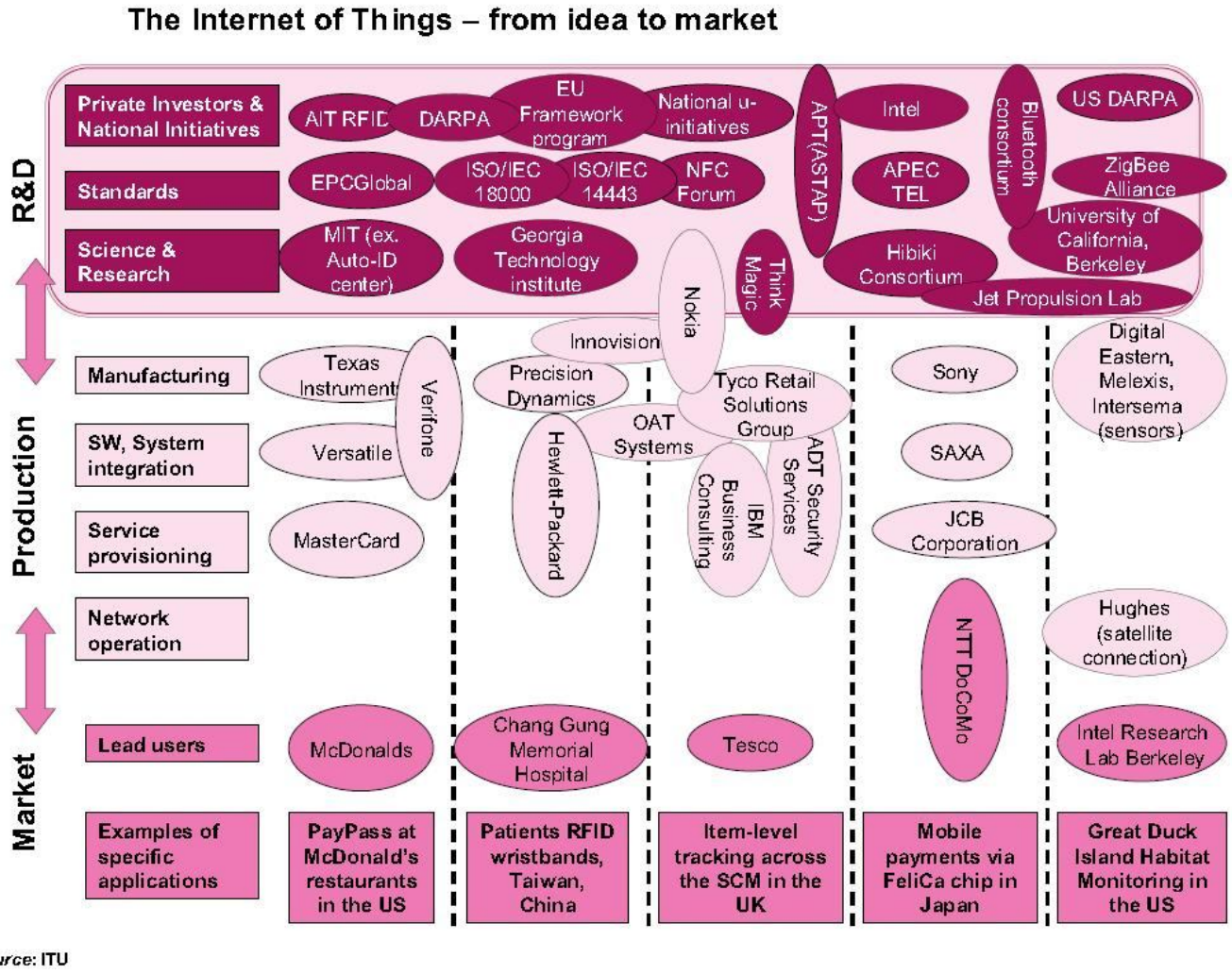
Salmon Information is processed for presentation, statistics and reports



Salmon Information is constantly stored on the database

Telenor Iris

But what about others?



Source: ITU

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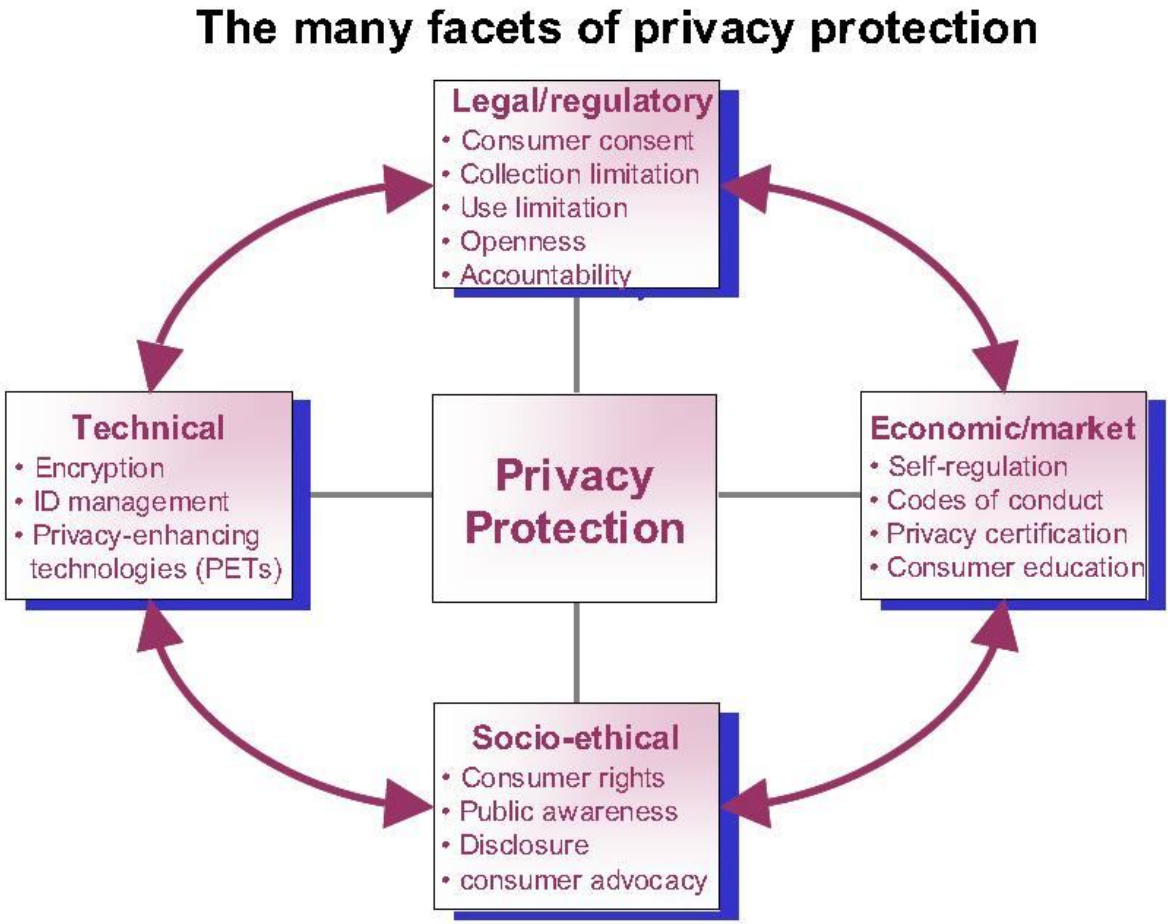
Challenges and concerns (or with great power comes great responsibility!)



Source: ITU

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Conclusions

- The industry is moving towards the ubiquitous computing vision of Mark Weiser
- Standardisation is taking place
- Commercial solutions have already been deployed, and many more are in the queue
- The technology is advancing
- Regulation should go hand in hand – invisible computing

Interested?

- We are very interested in hearing more about your research and market and which service areas may work there
- Please contact:
  - Marie Austenaa in Telenor Research & Innovation,
    e-mail: marie.austenaa@telenor.com,
  - Juan Carlos López in IRIS,
    e-mail: juan.calvet@telenor.com,

PART TWO OUTLINE

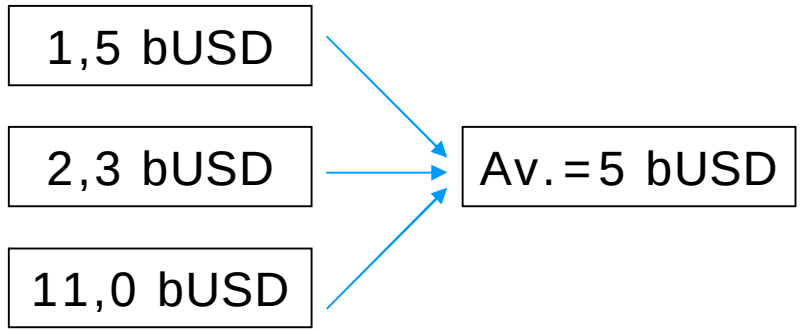
- R&D cases related to mobile services:
  - Social Networks – Data management in human networks
  - Connected Objects or the Internet of Things
  -  Mobile Search and Advertising
  - Open innovation platforms and testbeds

Mobile Search - Outline

- Introduction – why is mobile search important for operators?
- Analysis of the current state
- The operators strategic position
- Current situation with mobile search - What's broken with it?
- User Experience as the key to service uptake
- Future work and conclusions

Mobile search – why is it important for operators?

The mobile phone will become the new search arena



2008 – 2011 figures
Source: E-Marketer

- Always on → "Here and now" effect
- Highly personal → More relevant results and ads
- Higher penetration than PC → Wider audience for advertisers
- No one owns it yet → Very turbulent environment

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From web to mobile search (I)

Web search

- Dominated by the Big 3
  - Google, Yahoo! and Microsoft
  - High entry barriers

Mobile search

- No winner in the market yet
  - Branded search engines
  - White label providers
  - Hand set manufacturers
  - Mobile operator fight for a position
  - Lower entry barriers

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From web to mobile search (II)

Web search

- Revenue model
  - Advertising
  - Relevance
  - Ranking

Mobile search

- Revenue model
  - Advertising
  - Content selling
  - Data traffic
  - Retention of customers
  - Acquisition of new customers
  - Premium services

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From web to mobile search (III)

Web search

- Pros and cons
  - + Large screen
  - + Easy to type
  - + Rich content: long tail
  - - Not optimised to mobile browsers (but changing)

Mobile search

- Pros and cons
  - + Customer knowledge gives targeted search hits
  - + LBS services gives relevant search hits
  - + Payment services (CPA)
  - + Optimised to mobile browsers
  - – Small screen
  - – Time-consuming to type
  - – Little content: not long tail

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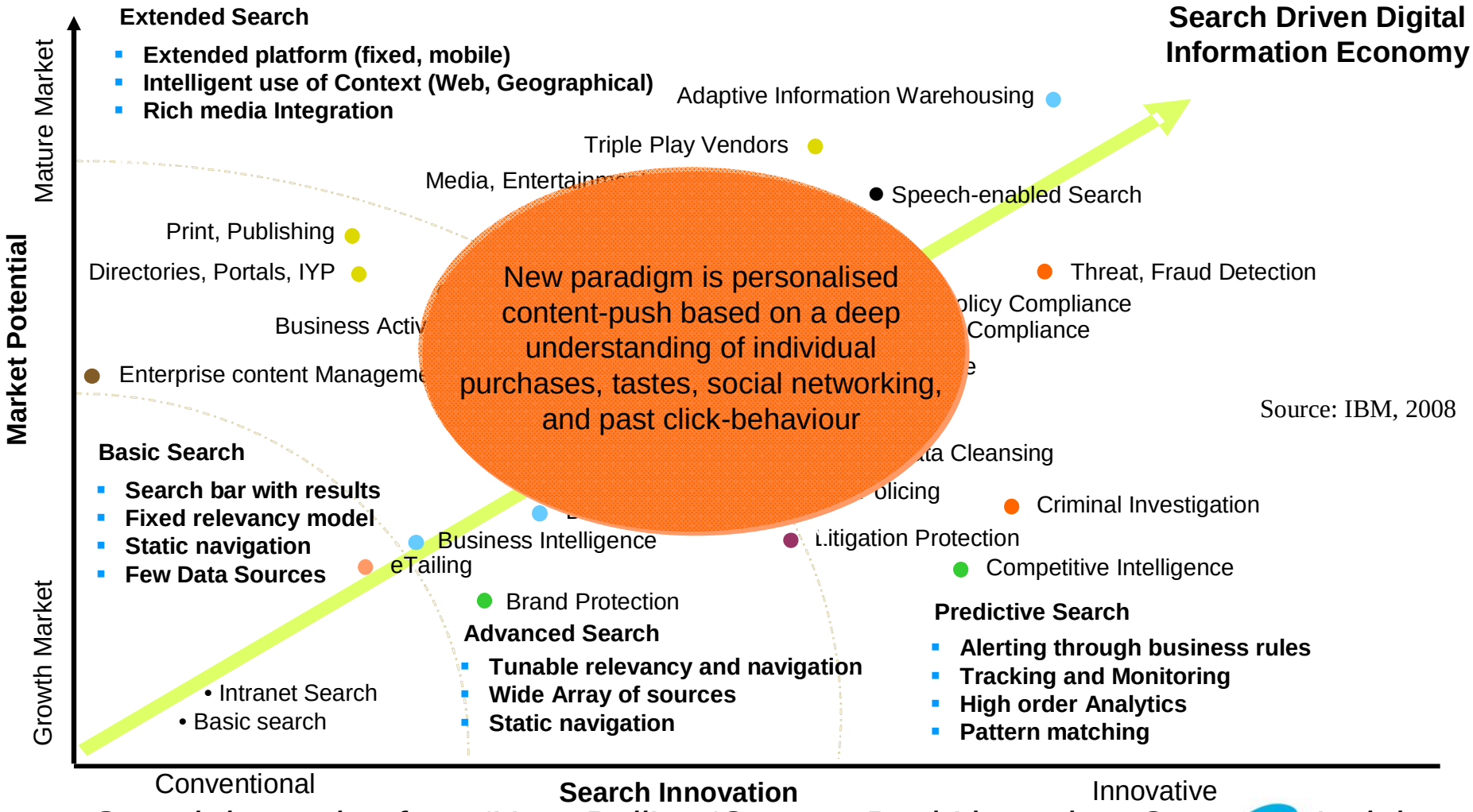
Search Opportunity Extends Well Beyond Encouraging Users to Interact with Content



Search is moving from 'User-Pull' to 'Content-Push' based on Customer Insight, Personalisation and Recommendation

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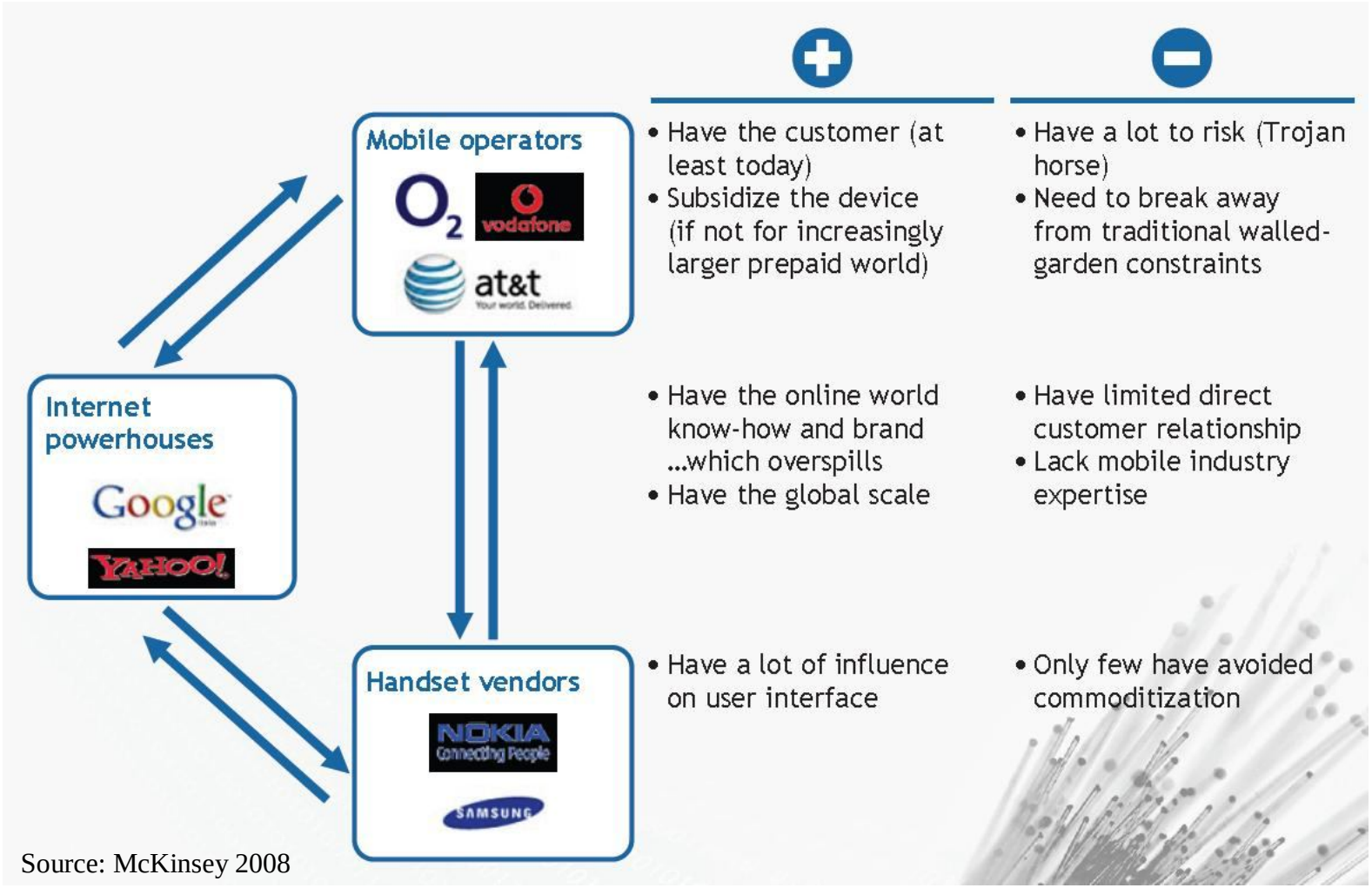
The giants are moving fast

- **Google – the leader**
  - Several agreements with operators and handset manufacturers
  - Own wap portal
  - Own services / applications – GPay!
  - Own GPhone
  - Own access?
- **Yahoo – the follower**
  - Several agreements with operators and handset manufacturers
  - Own client: Yahoo Go!
  - Own services / applications
- **Microsoft**
  - Live Search for mobile
- **Nokia and Iphone – The newcomers**
  - Own umbrella of services: Ovi, Twango
  - In-device search
  - Very aggressive in Location Based Services (LBS) – Acquisition of Navteq
  - Agreements with Yahoo and Google
  - Bet on LBS
  - Developing their own search engine or white labels

The giants are moving fast



Source: McKinsey 2008

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White label search providers

One example: Medio

- Comprehensive search across:
  - Downloadables
    - Music: Ringtones, Ringbacks, Full-tracks
    - Wallpaper
    - Games & Applications
  - Local Search
    - Yellow Pages / White Pages
  - Direct Answers
    - Weather
    - News, Sports,
    - Movies, Entertainment
    - Stock Quotes, Flight Status
    - more...
  - Portal partners
  - Mobile Web / Web

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To get a search engine !?

Google
YAHOO! SEARCH

Pros

- Fast implementation
- Brand may stimulate use

Cons

- Telcos isolated from search data
- Difficult to tailor to Telcos' needs
- Risk to educate our customers to become their customers
- Shared revenues

mcn
JumpTap
MEDIO

Pros

- More relevant and local results
- Tailored service
- Focus on mobile – best features
- Shared data
- No competitor
- Bigger revenues

Cons

- No brand
- Slower implementation due to tailored services and integration (6 weeks)
- Their plans ahead?

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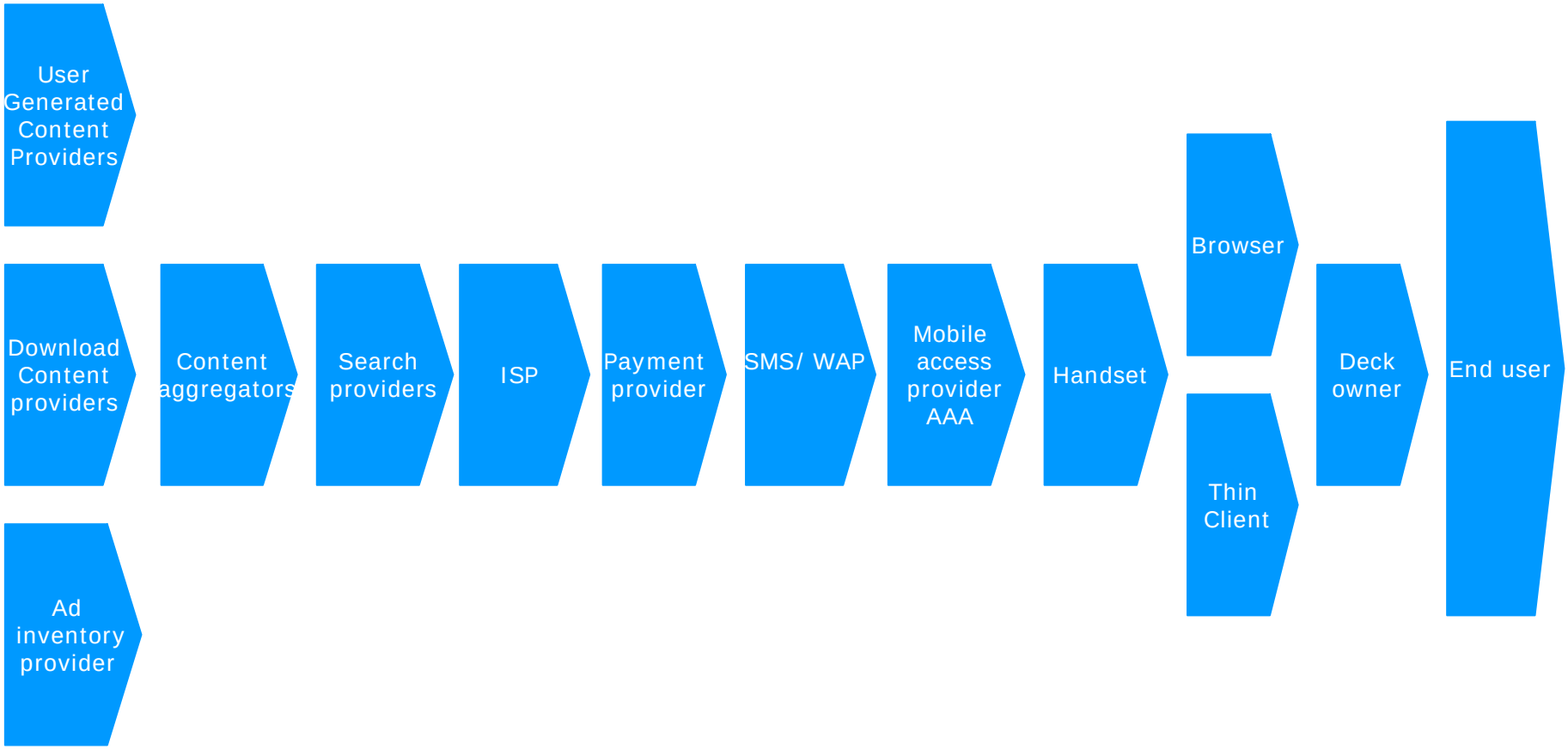
Hypothesis: Operators still have chances to enter the lucrative mobile search market



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How?
- Disaggregate the value chain by verticals

	Description	Comments
Mobile store-front search	• Media-specific for use on the mobile phone - e.g., ringtones • Carrier-defined catalogs with some off-portal providers	• Search boosts m-commerce • "Tuned" algorithm protects operator content
Local search	• Find local businesses, products, and services in a given geography (e.g., restaurants, bars) • Addresses traditional Yellow Page revenue streams	• Focused search can beat horizontal search engines • Links to mobile location-based assets
Vertical search	• Discrete areas of content (e.g., news, sports, travel) • Benefits from deeper content in a specific category, category-specific tuning, and algorithm	• Focused search can beat horizontal search engines • Operators can choose where they want to compete - e.g., video, games
Horizontal search	• General search mobile web sites • Traditional PC-based search transferred to the mobile	• Difficult to beat Google or Yahoo in horizontal search

Source: Carrier interviews, Yankee Group estimates, team analysis

User experience!!

- Content hidden ~25 clicks behind operator's portal

- Small screen (argh!)

- Data traffic pricing is a barrier – but is changing

- Consumers lack suitable content/services

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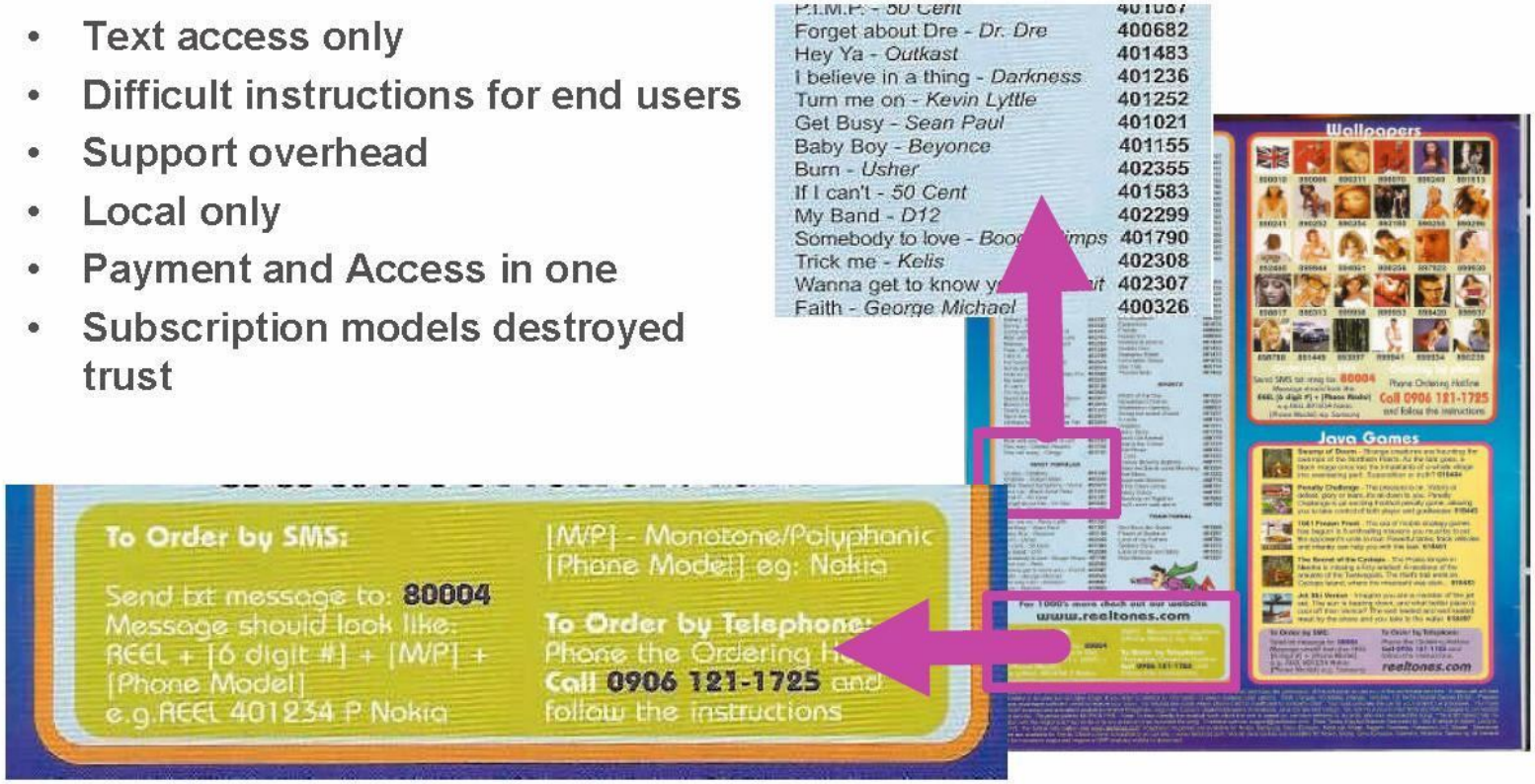
Some examples: what customers get

- Text access only
- Difficult instructions for end users
- Support overhead
- Local only
- Payment and Access in one
- Subscription models destroyed trust



Source: Bango, 2008

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Some examples: what customers get

- Example: Information about a DVD
  - Open a web browser on the phone (aprox. 4 clicks)
  - Open the dialog to enter a URL (aprox. 3 clicks)
  - Enter the site address (for example: www.google.com takes 30 clicks on a Nokia 6600)
  - Enter the name of the DVD to search (for example: matrix takes 16 clicks)
  - In total a user has to make an average of **53 clicks**

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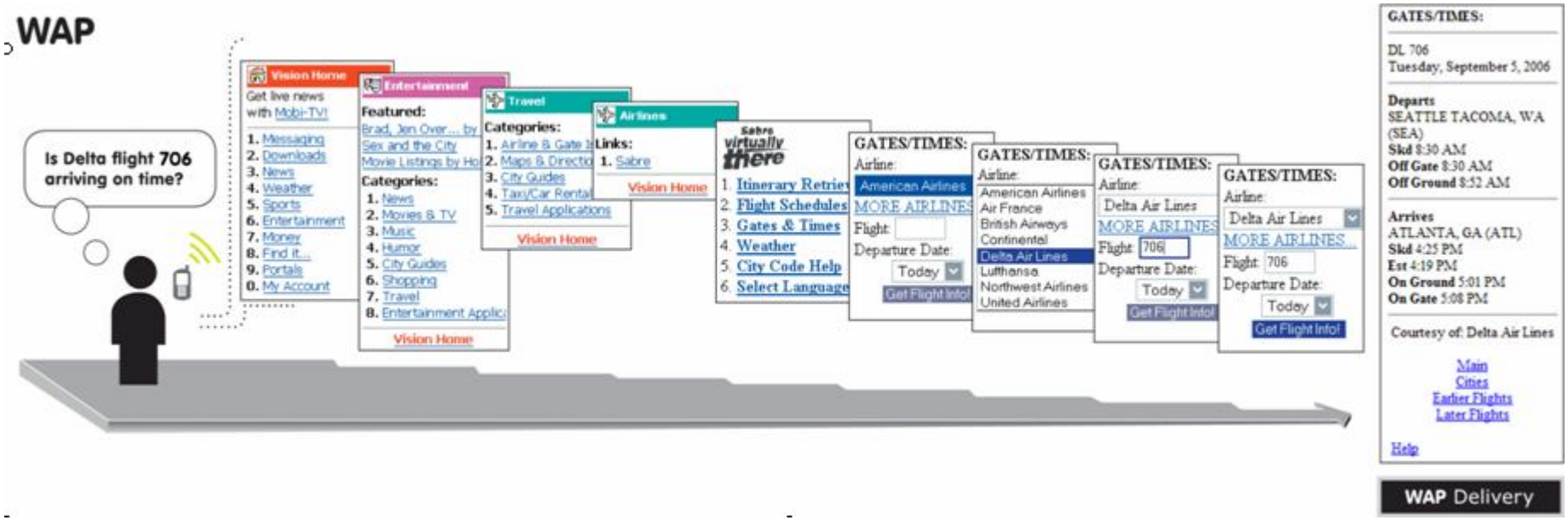
Some examples: what customers get

- Navigating – navigating - navigating



Source: Medio, 2008

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Some examples: what customers get

- Typing – typing – typing

Click distance (no of clicks)	Verizon	Cingular	T-Mobile USA	Orange UK	Vodafone UK	Vodafone Germany	E-Plus Germany	Average
Ringtone a	14	--	9	31	26	--	--	20
Ringtone b	11	23	10	22	64	14	21	24
Game a	8	19	19	35	28	41	24	25
Game b	38	31	21	34	32	34	37	32
Time needed (mins/secs)								
Ringtone a	5m	--	0m40	4m20	0m50	--	--	2m42
Ringtone b	8m	2m48	0m62	5m10	1m17	0m44	1m26	2m54
Game a	2m	2m04	1m32	8m25	1m09	1m27	1m02	2m32
Game b	4m	3m03	1m15	6m10	1m16	2m13	2m14	2m53

Source: MSearch-Groove, 2008

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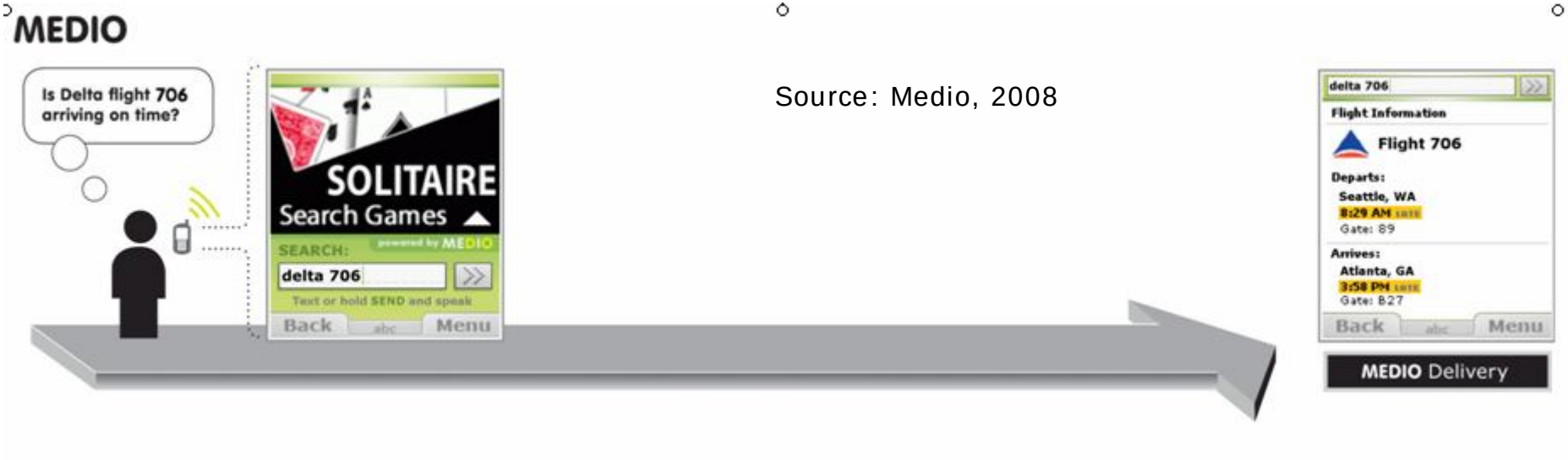
What searchers want…



Source: Medio, 2008

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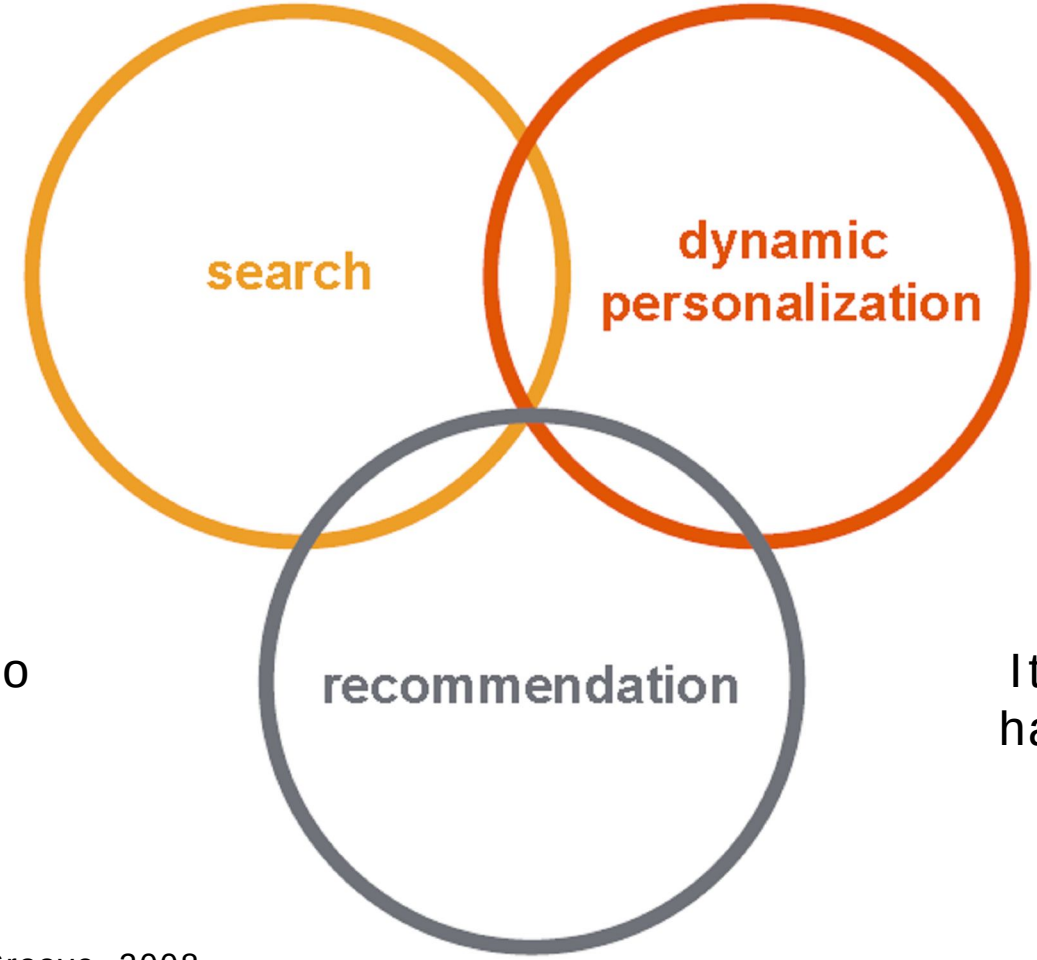
What searchers want… customisation and personalisation - really?



But its going to happen!!

It's already happening!!

Source: MSearch - Groove, 2008

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Much easier than keying… multimodal search

- Multimedia search
  - Search for tagged video, sound and photo files
- NFC as a gateway to mobile services
- Local Based Search (LBS):
  - Maps (GPS), GSM positioning, GPS positioning, Photos, Text
- Audio search (Gracenote, NMK (411-SONG), Rocket Mobile, Shazam, Ezmo)
  - Recognition of an audio file
- Voice search (GOOG-411, MS TellMe, *Mugene*)
  - Recognition of a melody
- Picture search (mobot, NTTDocomo Bandai, Nokia, Telenor R&I)
  - Recognition of a picture

Source: Telenor WS 28.06.07

Conclusions

- Mobile search is both seen as an opportunity and as a threat by Operators
- No clear winner but the fight is intense… the question is how to avoid being only a bit pipe for the Internet power houses
- No single solution: current strategy will vary according to local markets and the competitors power

- There is still a lot to do in the User Experience area… but things are starting to change

PART TWO OUTLINE

- R&D cases related to mobile services:
  - Social Networks
  - Connected Objects or the Internet of Things
  - Mobile Search and Advertising
  -  Open innovation platforms and testbeds

Open innovation platforms and test beds - Outline

- Introduction
- The momentum of the industry
- What should be the role for Operators
- Telenor Playground as a sample case
- Conclusions

Innovation challenges

- Industry has stopped looking for the killer-apps
- Converging industries
- Margins on existing services are dropping
- Need to shorten time to market
- Need to lower cost of integration

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Innovation opportunities

1. The industry is opening up. Players are opening the interfaces to their assets (services, platforms, …)
2. Partner / service ecosystems are building up around these players
3. Interfaces to platforms, services and telco infrastructures are becoming more and more standardized (web services, …)

→ *Providing us with the opportunity collaborate with new players, sharing competence and assets to enable new service and enrich existing services in our local markets.*

The industry is opening up

- Traditional web players - software:
  - Skype: https://developer.skype.com/
  - iPhone: http://developer.apple.com/iphone/devcenter/
  - Google Android: http://code.google.com/android/index.html
  - Yahoo: http://developer.yahoo.com/

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The industry is opening up

- Platform vendors – devices and software:
  - BEA: http://dev2dev.bea.com/
  - Microsoft: http://msdn2.microsoft.com/en-us/default.aspx
  - Ericsson: http://www.ericsson.com/mobilityworld
  - Nokia: http://www.nokia.com/A4384041

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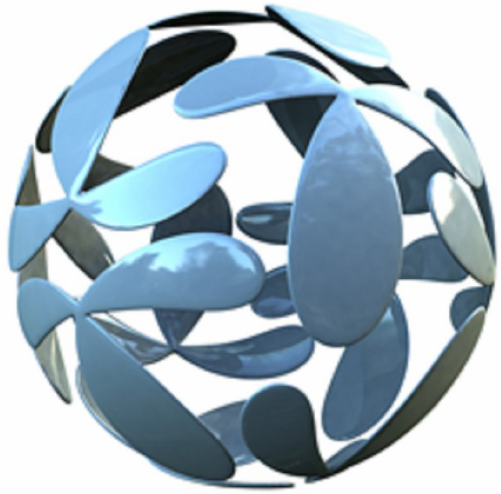
The industry is opening up

- Operators – mobility services:
  - Telenor: http://playground.telenor.com/
  - Vodafone: http://www.vodafonebetavine.net/web/guest/downloads
  - Sprint: http://developer.sprint.com/site/global/develop/p_develop.jsp
  - BT: http://web21c.bt.com/services
  - Orange: http://www.orangepartner.com/site/enuk/develop/p_develop.jsp

Main purposes of playground

- Respond to an opening industry by inviting partners in service development.
- Provide operators of the Telenor group with a volume of attractive and profitable services for them to test, evaluate and choose for local implementation.
- Provide our operators with an environment they can use to “test” local partners and services.
- Focus on long term standardization of interfaces, platforms and service development across the Telenor group.



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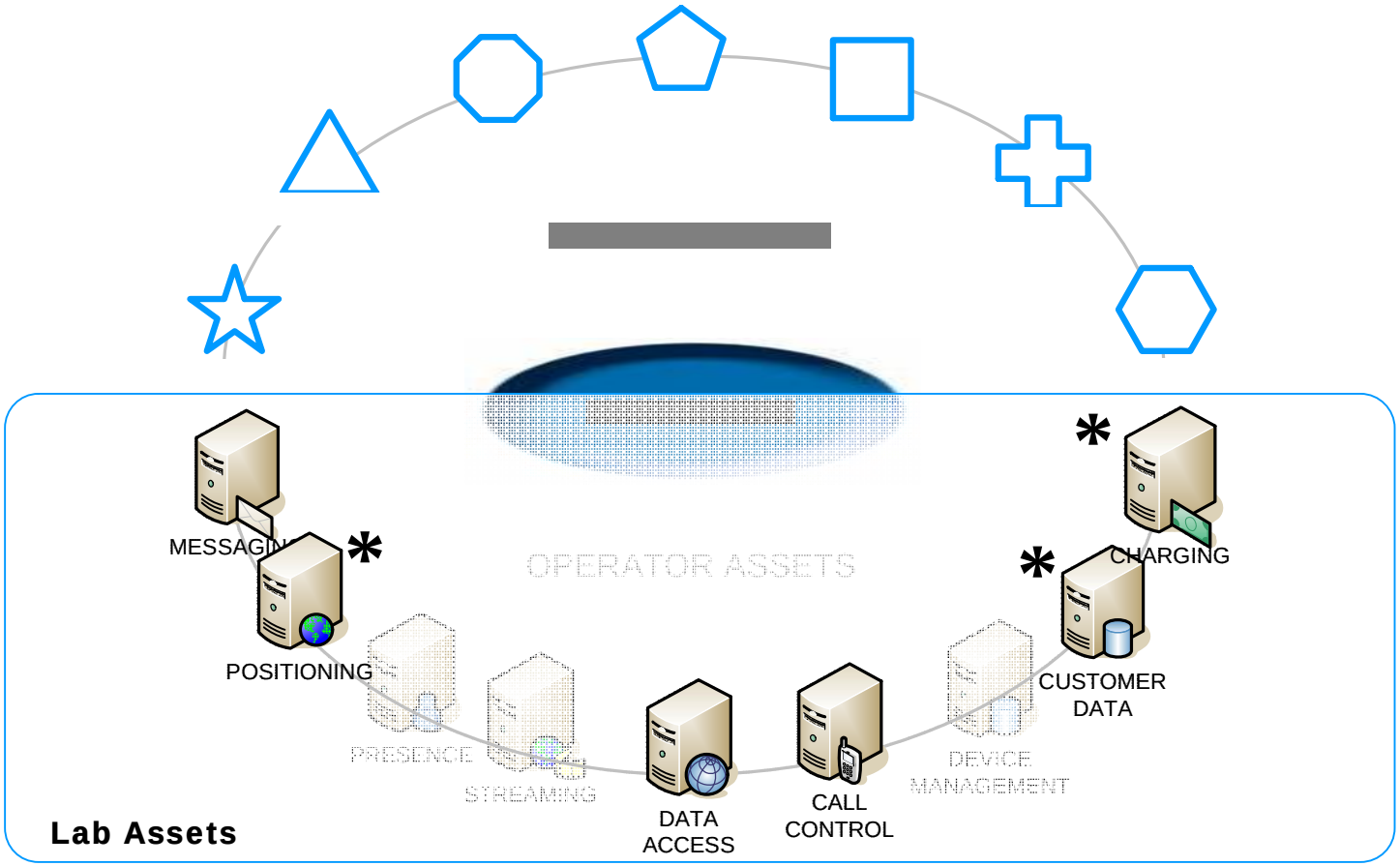
Providing access to our assets



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Telenor playground services

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Working with strategic partners…

- … in developing our lab and toolbox
- … in introducing portfolios of attractive services to the playground
- … in getting access to existing service partner eco-systems
- … in setting the direction for service innovation in Telenor

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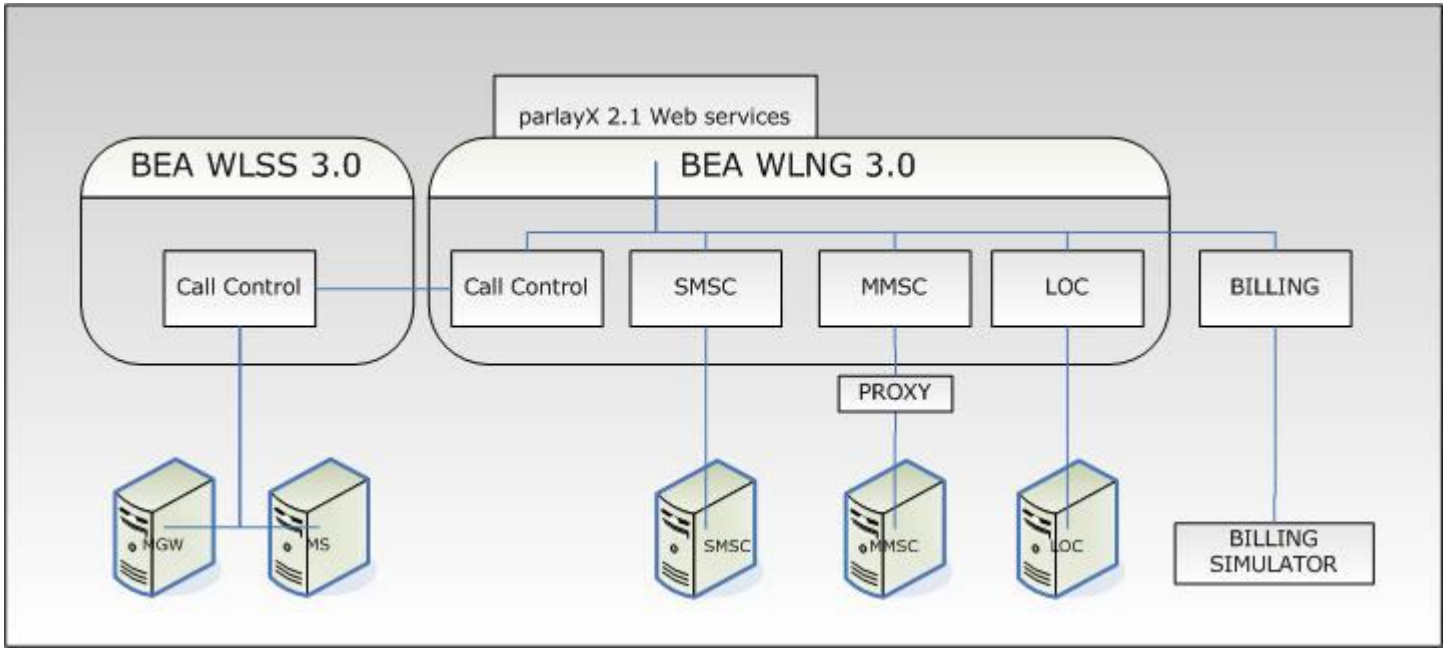
Playground lab – Some details



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Conclusions - For Telenor OpCos...

- Find relevant services and partners and get a fast track to build demos, deploy public trials, and pilots

- Use the playground environment as a testbed to:
  - Test mobility solutions
  - Run proof of concepts
  - Evaluate potential local partners
  - Provision of new services

Conclusions - For partners…

1. Go to the Playground portal and apply for partnership: http://playground.telenor.com/partner_registration.
2. The Playground team will use this as input for an initial evaluation and contact you for a potential meeting.
3. If and when both parties agree on the scope and value of a Playground partnership, a process will be initiated to implement your services on Playground (demo and service and company descriptions on the Playground portal).
4. When your services are available on the Playground, we will work together with you to promote and demonstrate your service to the Telenor operating companies.

Interested?

- We are very interested in hearing more about your research and market and which service areas may work there
- Please contact:
  - http://playground.telenor.com

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